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TR 68-13

TECHNICAL REPORT NO. 68-13

OPERATION OF THE UINTA BASIN SEISMOLOGICAL OBSERVATORY,

Quarterly Report No. 7

1 November 1967 through 31 January 1968

GEOTECH

A TELEDYNE COMPANY

TECHNICAL REPORT NO. 68-13

OPERATION OF THE UINTA BASIN SEISMOLOGICAL OBSERVATORY, QUARTERLY REPORT NO. 7

1 November 1967 through 31 January 1968

Sponsored by

Advanced Research Projects Agency
Nuclear Test Detection Office
ARPA Order No. 624

TELEDYNE INDUSTRIES
GEOTECH DIVISION
3401 Shiloh Road
Garland, Texas

15 February 1968

IDENTIFICATION

AFTAC Project No:	VELA T/6705
Project Title:	Operation of UBSO
ARPA Order No:	624
ARPA Program Code No:	6F10
Name of Contractor:	Teledyne Industries, Geotech Division
Date of Contract:	1 May 1966
Amount of Contract and Amendment 1:	$624,897
Amount of Amendment 2:	$374,600
Total:	$999,497
Contract No:	AF 33(657)-16563
Contract Expiration Date:	31 October 1968
Program Manager:	B. B. Leichliter, BR1-2561

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ILLUSTRATIONS

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ABSTRACT

This report describes the operations of the Uinta Basin Seismological Observatory (UBSO) from 1 November 1967 through 31 January 1968. Modifications and additions to the observatory instrumentation are described, and tests to improve the operations of the observatory are reported. Also discussed is the status of special investigations designed to evaluate and improve the detection capability of the observatory.

OPERATION OF UBSO - QUARTERLY REPORT NO. 7
1 NOVEMBER 1967 THROUGH 31 JANUARY 1968

1. INTRODUCTION

1.1 AUTHORITY

The work described in this report was supported by the Advanced Research Projects Agency, Nuclear Test Detection Office, and was monitored by the Air Force Technical Applications Center (AFTAC), under Contract AF 33(657)-16563. The statement of work for this contract is shown in the appendix.

1.2 HISTORY

The Uinta Basin Seismological Observatory (UBSO) was constructed under Contract AF 33(657)-7185. Site selection and noise surveys were accomplished by Geotech; the final decision on the observatory location was made by AFTAC. Texas Instruments, Incorporated (TI) was responsible for the construction of all physical facilities.

Contract AF 33(600)-43486, issued to TI, contained the authority for equipping and operating UBSO. The instrumentation was supplied by Geotech and was installed under the direction of Geotech personnel under subcontract to TI. Texas Instruments operated the observatory from November 1962 until 1 July 1963. Under Projects VT/1124 and VT/5054, Contract AF 33(657)-12373, Geotech operated UBSO from 1 July 1963 through 30 April 1966.

2. OPERATION OF UBSO

2.1 GENERAL

Data are recorded at UBSO on a 24-hour basis. The observatory is normally manned 8 to 10 hours a day, 5 days a week. On weekends and holidays, a skeleton crew mans the observatory 8 hours a day; however, additional personnel are on call in case of emergency.

The UBSO array configuration is shown in figure 1.

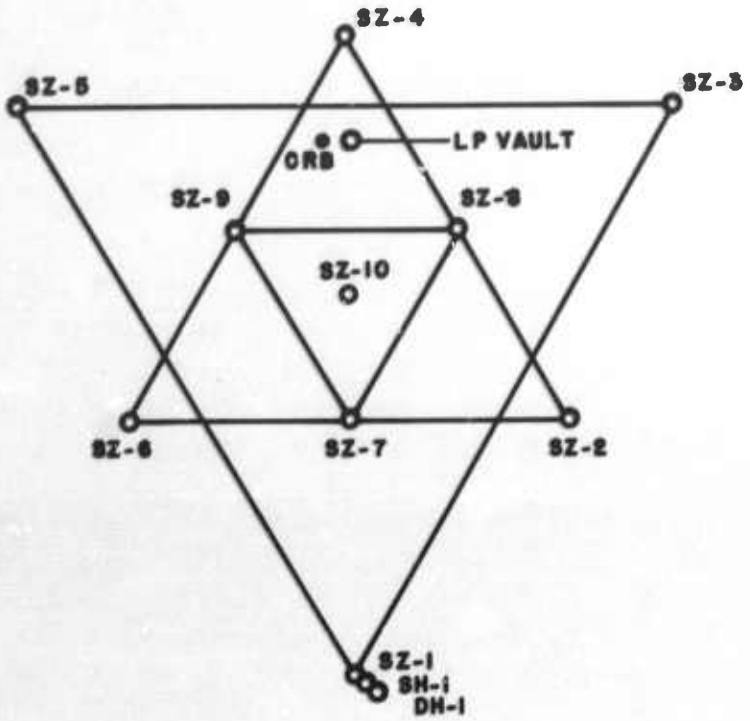

Figure 1. Orientation and configuration of UBSO arrays

The U. S. Corps of Engineers, in Sacramento, California, called UBSO on 2 January 1968 in regard to a request from Tennessee Oil Company to drill a well on UBSO property. They were referred to the Project Office.

On 24 January 1968, Petty Geophysical Company detonated a series of explosions along the northern boundary of UBSO as part of a reflection survey being conducted for Shell Oil Company. Selected instruments were attenuated during the blasting.

2.2 SEISMOGRAPH OPERATING PARAMETERS

2.2.1 Standard Seismographs

The operating parameters and the tolerances for the standard observatory seismographs are shown in table 1. These parameters are reset if the frequency response of a seismograph is found to be out of tolerance. The frequency response norms and their respective tolerances are shown in table 2. The frequency responses of the UBSO seismographs, as normally operated, are shown in figure 2.

2.2.2 Filters for Shallow-Buried Array Summations

The summation of the ten-element shallow-buried array is filtered by a band-pass filter with the following settings: a high-cut corner frequency of 3 cps and a low-cut corner frequency of 0.8 cps, both at a cutoff rate of 18 dB per octave.

2.3 DATA CHANNEL ASSIGNMENTS

The current data-channel assignments and normal operating magnifications for all UBSO data groups are shown in table 3. The key to the designators used in the data-channel assignments is given in table 4.

2.4 SHIPMENT OF DATA TO THE SEISMIC DATA LABORATORY (SDL)

Magnetic-tape seismograms are shipped to SDL about 15 days after the end of the month during which they are recorded. The seismograms from magnetic-tape recorders 1, 2, 3, and 4 recorded at UBSO through 31 December 1967 have been shipped to SDL.

All 16-millimeter film seismograms recorded at UBSO through 30 November 1967 were sent to SDL. More recent films are currently held in Garland for special studies.

Table 1. Operating parameters and tolerances of seismographs at UBSO

Seismograph				Operating parameters and tolerances					Filter settings	
		Seismometer								
System	Comp	Type	Model	T_s	λ_s	T_g	λ_g	σ^2	Bandpass at 3 dB cutoff (sec)	Cut off rate at SP side (dB/oct)
SP	Z and H	Johnson-Matheson	7515 6480	1.25 ±2%	0.51 ±5%	0.33 ±5%	0.65 ±5%	0.03	0.1-100	12
SP	SZ	Geotech	18300	1.25 ±2%	0.51 ±5%	0.33 ±5%	0.65 ±5%	0.053	0.1-100	12
SP	Z	UA Benioff	1051	1.0 ±5%	1.0	0.083 ±5%	≈1.4	1.0	-	-
BB	Z	Geotech	7505	12.5 ±5%	0.485 ±5%	0.64 ±5%	9.0 ±5%	0.0007	0.05-100	12
BB	H	Geotech	8700A	12.5 ±5%	0.485	0.64 ±5%	9.0 ±5%	0.0007	0.05-100	12
LP	Z	Geotech	7505A	20.0 ±5%	0.74 ±5%	110 ±10%	0.85 ±10%	0.63	25-1000	12
LP	H	Geotech	8700A	20.0 ±5%	0.74 ±5%	110 ±10%	0.85 ±10%	0.63	25-1000	12

KEY

SP	Short period	T_s	Seismometer free period (sec)
BB	Broad band	T_g	Galvanometer free period (sec)
LP	Long period	λ_s	Seismometer damping constant
UA	Unamplified (i.e., earth powered)	λ_g	Galvanometer damping constant
		σ^2	Coupling coefficient

Table 2. Calibration norms and operating tolerances for frequency responses of the standard seismographs at UBSO

SP Vertical 18300 and SP Johnson-Matheson Vertical and Horizontal				LP Vertical and Horizontal [c]			
f (cps)	T (sec)	R. M.	A. T. (±%)	f (cps)	T (sec)	R. M.	A. T. (±%)
0.2	5.0	0.0113	10	0.01	100	0.246	20
0.4	2.5	0.0950	7.5	0.0125	80	0.377	20
0.8	1.25	0.685	5	0.0167	60	0.589	15
1.0	1.0	1.0	-	0.02	50	0.745	15
1.5	0.67	1.52	5	0.025	40	0.899	10
2.0	0.5	1.90	5	0.033	30	1.06	5
3.0	0.33	2.12	7.5	0.04	25	1.0	-
4.0	0.25	1.87	12	0.05	20	0.822	5
..0	0.167	1.15	20	0.0667	15	0.506	10
8.0	0.125			0.10	10	0.173	20
10.0	0.100			0.143	7	b	a

BB Vertical and Horizontal			
f (cps)	T (sec)	R. M.	A. T. (±%)
0.04	25.0	0.104	20
0.06	16.7	0.350	20
0.08	12.5	0.775	15
0.1	10.0	0.950	10
0.2	5.0	1.0	5
0.4	2.5	1.0	5
0.8	1.25	1.0	-
1.6	0.625	1.0	5
3.2	0.312	1.0	10
6.4	0.156	0.980	15

KEY

R. M. Relative magnification
A. T. Amplitude tolerance
a Tolerance not established in the period
b Measurements not reliable due to interference from microseismic background noise
c These norms and tolerances apply to the broad-response, long-period system (LP1).

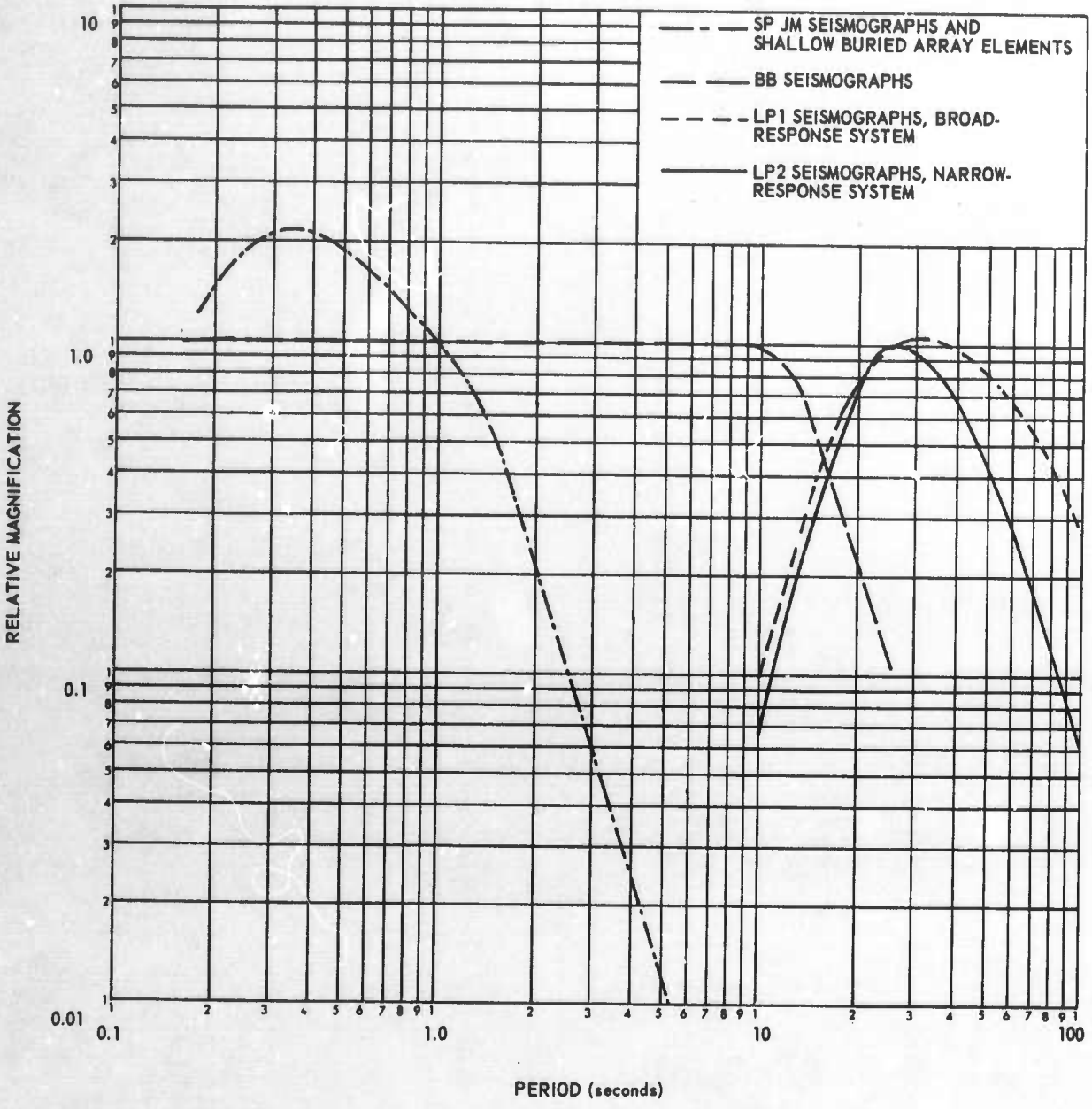

Figure 2. Normalized response characteristics of the standard seismographs at UBSO

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Table 3. Data channel assignments and normal operating magnifications at UBSO

DEVELOCORDERS

FAST SPEED 30mm/min.

DATA GROUP 5044 — SP Primary

Channel	Trace	Mag.
1	V	20K
2	SZ1	600K
3	SZ3	600K
4	SZ5	600K
5	SZ2	600K
6	SZ4	600K
7	SZ6	600K
8	SZ7	600K
9	SZ8	600K
10	SZ9	600K
11	ΣSSF	6000K
12	ΣSS	1500K
13	SZ10	600K
14	NSP	600K
15	ESP	600K
16	WWV	---

DATA GROUP 5064

Channel	Trace	Mag.
1	V	2K
2	MS1	0.75μb/mm
3	MS2	0.75μb/mm
4	---	---
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---
11	---	---
12	SZ8	600K
13	USO-SP	---
14	USO-Time	---
15	WI	3 mph = 1 mm; S = 0.8 mm (E = 6 mm)
16	WWV	---

DATA GROUP 5076

Channel	Trace	Mag.
1	SZ10L	60K
2	NSPL	60K
3	ESPL	60K
4	Z10LL	5K
5	NSPLL	5K
6	ESPLL	5K
7	SZ1	600K
8	SZ3	600K
9	SZ5	600K
10	ΣSSF	6000K
11	ΣSS	1500K
12	Z10	600K
13	NSP	600K
14	ESP	600K
15	TCDMG (Tape #1)	---
16	WWV	---

SLOW SPEED 3mm/min.

DATA GROUP 5074

Channel	Trace	Mag.
1	WI	3 mph = 1 mm; S = 0.8 mm (E = 6 mm)
2	SZ2	300K
3	ZLP1	25K
4	NLP1	25K
5	ELP1	25K
6	ZLP2	100K
7	NLP2	100K
8	ELP2	100K
9	ML1	3μb/mm
10	ML2	3μb/mm
11	USO - LP -	
12	ZBB	1.0K
13	NBB	1.0K
14	EBB	1.0K
15	WWV	
16	-----	----

LP TEST

Channel	Trace	Mag.
1	Triax 1	---
2	Triax 2	---
3	Triax 3	---
4	ΣTriax	---
5	ZLP2	---
6	ZCT	---
7	NLP2	---
8	NCT	---
9	ELP2	---
10	ECT	---
11	WI	3 mph = 1 mm; S = 0.8 mm (E = 6 mm)
12	---	
13	---	
14	---	
15	---	
16	---	

MAGNETIC TAPE RECORDERS

DATA GROUP 5037 — No. 1

Channel	Trace
1	TCDMG
2	ZBB
3	NBB
4	EBB
5	NSP
6	ESP
7	Comp.
8	---
9	---
10	---
11	Z10LL
12	NSPLL
13	ESPLL
14	WWV & Voice

DATA GROUP 5041 — No. 2

Channel	Trace
1	TCDMG
2	Triax 1
3	Triax 2
4	Triax 3
5	WI
6	Test
7	Comp.
8	ZLP1
9	NLP1
10	ELP1
11	ZLP2
12	NLP2
13	ELP2
14	WWV & Voice

DATA GROUP 5025 — No. 3

Channel	Trace
1	TCDMG
2	SZ1
3	SZ2
4	SZ3
5	SZ4
6	SZ5
7	Comp.
8	SZ6
9	SZ7
10	SZ8
11	SZ9
12	SZ10
13	ΣSS
14	WWV & Voice

DATA GROUP 5035 — No. 4

Channel	Trace
1	TCDMG
2	USOZSP
3	USOZLP
4	USO Time
5	ΣSSF
6	---
7	Comp.
8	---
9	---
10	---
11	---
12	---
13	---
14	WWV & Voice

Table 4. Key to the designations used in the data format assignments at UBSO

Z	Amplified vertical short-period seismograph from a surface site identified by a suffix number
SZ	Amplified vertical short-period seismograph from a shallow-buried site identified by a suffix number
NSP	Amplified north-south short-period seismograph
ESP	Amplified east-west short-period seismograph
V	Unamplified vertical short-period seismograph
ZLP1	Vertical long-period seismograph, broad response
NLP1	North-south long-period seismograph, broad response
ELP1	East-west long-period seismograph, broad response
ZLP2	Vertical long-period seismograph, narrow response
NLP2	North-south long-period seismograph, narrow response
Mag.	Magnification (see note)
TCDMG	Time code data magagement group
ELP2	East-west long-period seismograph, narrow response
ZBB	Vertical broad-band seismograph
EBB	East-west broad-band seismograph
ΣSS	Summation of SZ1 through SZ10
ΣSSF	ΣSS filtered
ML1	Long-period microbarograph (inside LP vault)
ML2	Long-period microbarograph (outside LP vault)
MS1	Short-period microbarograph (inside LP vault)
MS2	Short-period microbarograph (outside LP vault)
WWV	Radio time (WWV, STS, and voice on tape)
Test	Test instrumentation
Comp	Wow and flutter compensation
USO-LP	Unmanned seismological observatory long-period seismograph
WI	Anemometer-wind speed and direction
ECT	Coordinate transform of Triax 1, Triax 2, Triax 3 (east)

Table 4, Continued

USO-SP	Unmanned seismological observatory short-period seismograph	NCT	Coordinate transform of Triax 1, Triax 2, Triax 3 (north)
Triax	Experimental 3-component long-period seismograph		
ΣTriax	Summation of Triax 1, Triax 2, and Triax 3		
ZCT	Coordinate transform of Triax 1, Triax 2, Triax 3 (vertical)		

NOTE

Magnification of short-period measured at 1 cps; broad-band measured at 0.8 cps; long-period measured at 0.04 cps

2.5 QUALITY CONTROL

Quality control checks were made on randomly selected runs of all recordings from the observatory. Results of the checks were sent to the observatory for corrective action as necessary.

3. EVALUATE DATA AND PROVIDE MOST EFFECTIVE OBSERVATORY POSSIBLE

3.1 REVISED MAGNETIC TAPE RECORDER LOGS

On 2 January 1968, the magnetic tape recorder logs were revised to show the equivalent ground motion of the tape recorder noise and of the tape recorder distortion level. The revised logs also show the calibration voltage (peak-to-peak) for each seismograph system. Operational tolerances for the calibration voltages were specified as follows:

a. Short-period systems - ±5 percent of a convenient norm to be established by the station;

b. All systems other than short-period - ±10 percent of the norm established.

The calibration voltages will be monitored weekly at the tape recorder "input" jacks and daily, indirectly, by monitoring the system magnification on the Develocorder.

Figure 3 shows the revised form of the tape recorder log.

3.2 ADDITIONS TO INSTRUMENTATION AT UBSO

3.2.1 Vertical Array

The cable spooling equipment and 10,434 feet of 7H4 cable were delivered to UBSO on 10 January. Geotech personnel and Mr. C. D. Brownlee from Gearhart-Owens arrived at UBSO to spool the cable and to install the vertical array on 10 January. The new cable was installed on the deep-hole winch by 12 January.

To facilitate installation of the array during extremely cold weather (-24°F) a semipermanent, heated plywood building was constructed over the deep-hole tripod. At the close of the report period, the first three seismometers were checked and placed in the hole.

TAPE RECORDER LOG

Observatory: _____
Date: _____
Run No: _____
Record starts: _____ _____
ends: _____ _____

Recorder No: _____
Data Trunk:* _____
Data Group: _____

From	To	Time Corr

Chan	Inst	Calibration					Cal. Level (V. p-p)	Approx. Dist. Level (mμ p-p)	Approx. Recorder Noise (mμ p-p)	Remarks
		Time (Z)	Equiv Ground Motion (mμ)	** S/N Ratio C	** S/N Ratio U	Mod Sens (V/100%)				
1	TCD MG									
2										
3										
4										
5										
6										
7	Comp									
8										
9										
10										
11										
12										
13										
14	WWV									

Operator _____ Station Engineer _____

Form 407 *TFSO only
(Revised 2 Jan. 1968)

C - Compensated
U - Uncompensated
** - Measured with ____ bandwidth filter

Figure 3. Revised Tape Recorder Log

3.2.2 Long-Period Array

Equipment procurement and preparations for construction of the vaults for the UBSO long-period array were continued throughout the reporting period. Mr. Roy Book, U. S. Army Corps of Engineers, was furnished legal descriptions of the acreage required for the vault installations, a copy of the access platt to the LP4 site, and physical descriptions of the vault installations. At the request of the Project Officer, Mr. Book obtained 1-year special use permits for sites LP1, LP2, LP3, and LP5 from the Bureau of Land Management so that actual site construction could be started while the request for permanent permits was pending.

Finalization of a lease agreement with the State of Utah for the LP4 site and a lease agreement with the Ute Indian Tribe for the LP6 site is still pending. By the end of the reporting period, these two leases had been negotiated; however, they will not be finalized until the end of February or the first part of March.

At the end of January, requests for quotation for fabricating the long-period vaults, drilling the holes in which the vaults are to be installed, and installing the vaults were being finalized. These requests will be distributed in early February, and vault installation will be started in mid-March.

Design and testing of the gain-ranging amplifier and digital data transmission system being developed by Geotech are in the final stages. If our enginering change Proposal P-1115 is accepted, we will begin work on the digital system for the UBSO array immediately.

3.2.3 Long-Period Triaxial Seismometer

The experimental long-period triaxial seismometer was installed during the report period. The outputs are being recorded on the Develocorder, Helicorder, and magnetic-tape recorder. UBSO personnel assisted in the installation and recording of the triaxial seismograph throughout the reporting period.

3.3 LONG-PERIOD MAGNETIC-TAPE SEISMOGRAMS

As a result of the Project Office having difficulty in playing back magnetic-tape data from the long-period systems, the Garland support group selected samples for playback tests from tapes available in Garland. Three samples, each, from the LP1 and the LP2 systems were played back. In general, the signal resolution observed on the tape playbacks was comparable to that on the corresponding film seismograms, although LP1 was being recorded on both film and tape at a very low sensitivity. The reason for the low

recording sensitivity was two fold - first, to provide a system on which large signals would not clip and second, because the broad response permits the passage of 6-second microseisms which limits the useful, operational sensitivity. The results of the playback tests indicate, however, that the long-period systems could be more usefully operated at a higher sensitivity. As a result, on 30 November, the number of volts for 100 percent modulation of the magnetic-tape recorder oscillators was changed on the LP2 system from ±2.8 to ±1.4, and on the LP1 system from ±1.4 to ±0.7. In addition, the equivalent ground motion of the routine calibration of the long-period systems was changed from 2000 to 1000 millimicrons.

4. TRANSMIT DAILY MESSAGES TO THE COAST AND GEODETIC SURVEY

The arrival time, period, and amplitude measurements for events recorded at UBSO were reported daily to the Director of the Coast and Geodetic Survey in Washington, D. C. The number of events, by type, reported by UBSO during each month in this reporting period is shown in table 5. Table 6 shows the total number of events recorded by the observatory; the number of epicenters determined by the C&GS and reported in the "Earthquake Data Report"; the percent of the C&GS hypocenters for which the C&GS report listed a UBSO P or PKP phase; the percent of C&GS hypocenters for which UBSO recorded a P or PKP phase, as determined from associated data; and the percent of C&GS hypocenters for which UBSO recorded a P, PKP, or later phase, based on updated associated data for July, August, September, and October 1967. Lists of more recent epicenters have not been completed by the C&GS.

Figures 4 and 5 show the world-wide distribution of the C&GS-located epicenters for July, August, and September 1967. The three types of symbols used to show the locations of the epicenters represent the detection by UBSO of a P or PKP, the detection of an event in which the first recorded arrival was not P or PKP, and no detection.

5. PUBLISH MONTHLY EARTHQUAKE BULLETIN

Data from UBSO were combined with data from BMSO, CPSO, TFSO, and WMSO and published in a multistation earthquake bulletin. The bulletins for July, August, and September 1967 were published and distributed during the reporting period. The ABP output for the October bulletin was received from the Seismic Data Laboratory on 18 January, and the October bulletin is scheduled for distribution about 15 February 1968.

Table 5. Events reported to the C&GS by UBSO during November and December 1967 and January 1968

Month	Local	Near regional	Regional	Teleseisms	Total
November	22	323	20	1067	1432
December	8	275	80	836	1199
January	20	276	18	1053	1367

Table 6. Percentage of hypocenters reported in the C&GS "Earthquake Data Report" for which UBSO data were used

Month	No. events reported by UBSO	No. C&GS hypocenters	Percent of C&GS hypocenters for which the C&GS listed a UBSO P or PKP arrival	Percent of C&GS hypocenters for which UBSO recorded a P or PKP phase, based on associated data	Percent of C&GS hypocenters for which UBSO recorded a P, PKP, or later phase, based on updated associated data
July	1442	439	60.2	69.3	72.5
August	1678	395	50.0	71.9	76.7
September	1577	411	59.1	72.9	77.8
October	1647	388	53.4	71.4	78.2

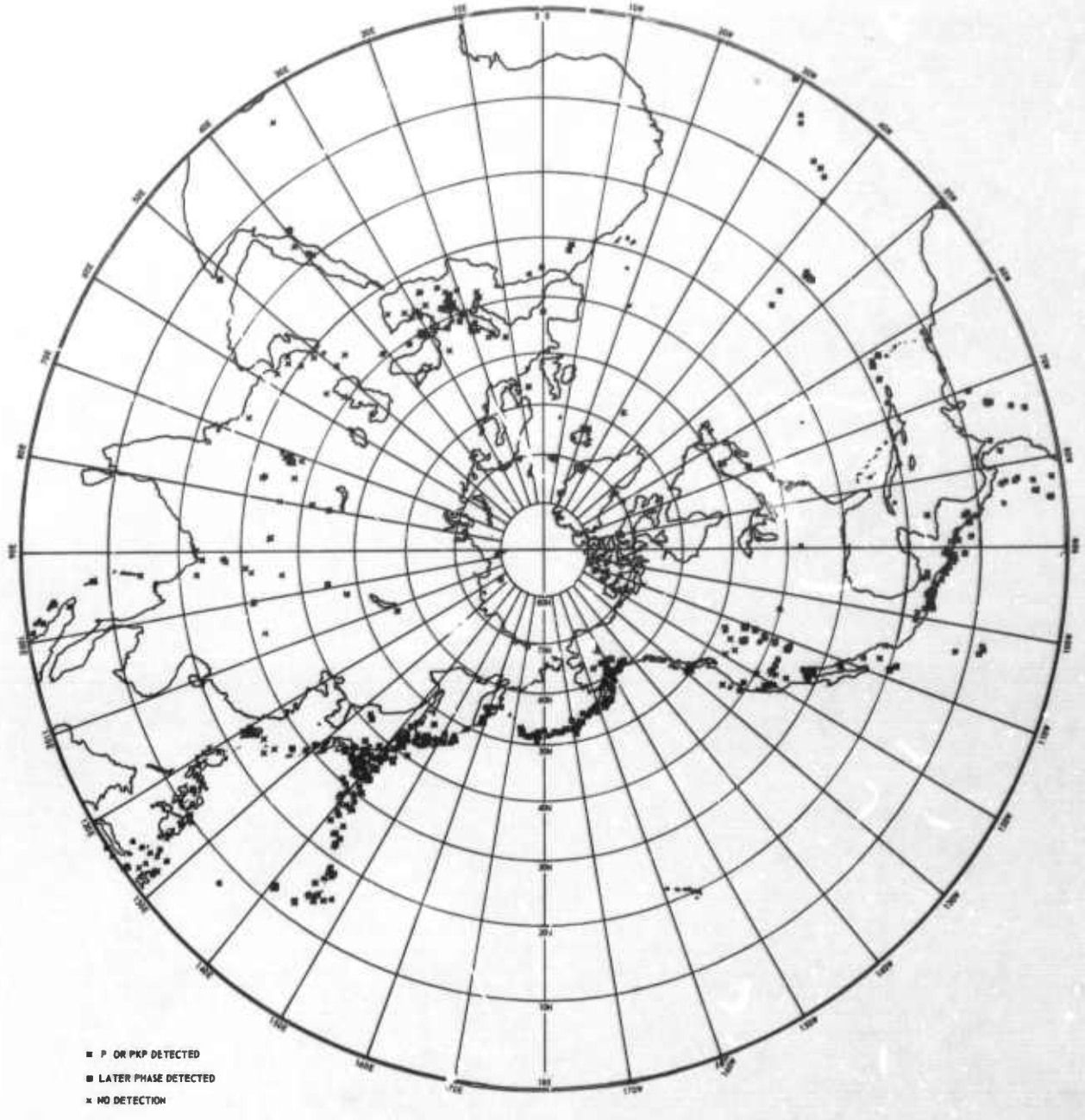

Figure 4. Distribution of Coast and Geodetic Survey located epicenters in the northern hemisphere for July, August, and September 1967

G 3179

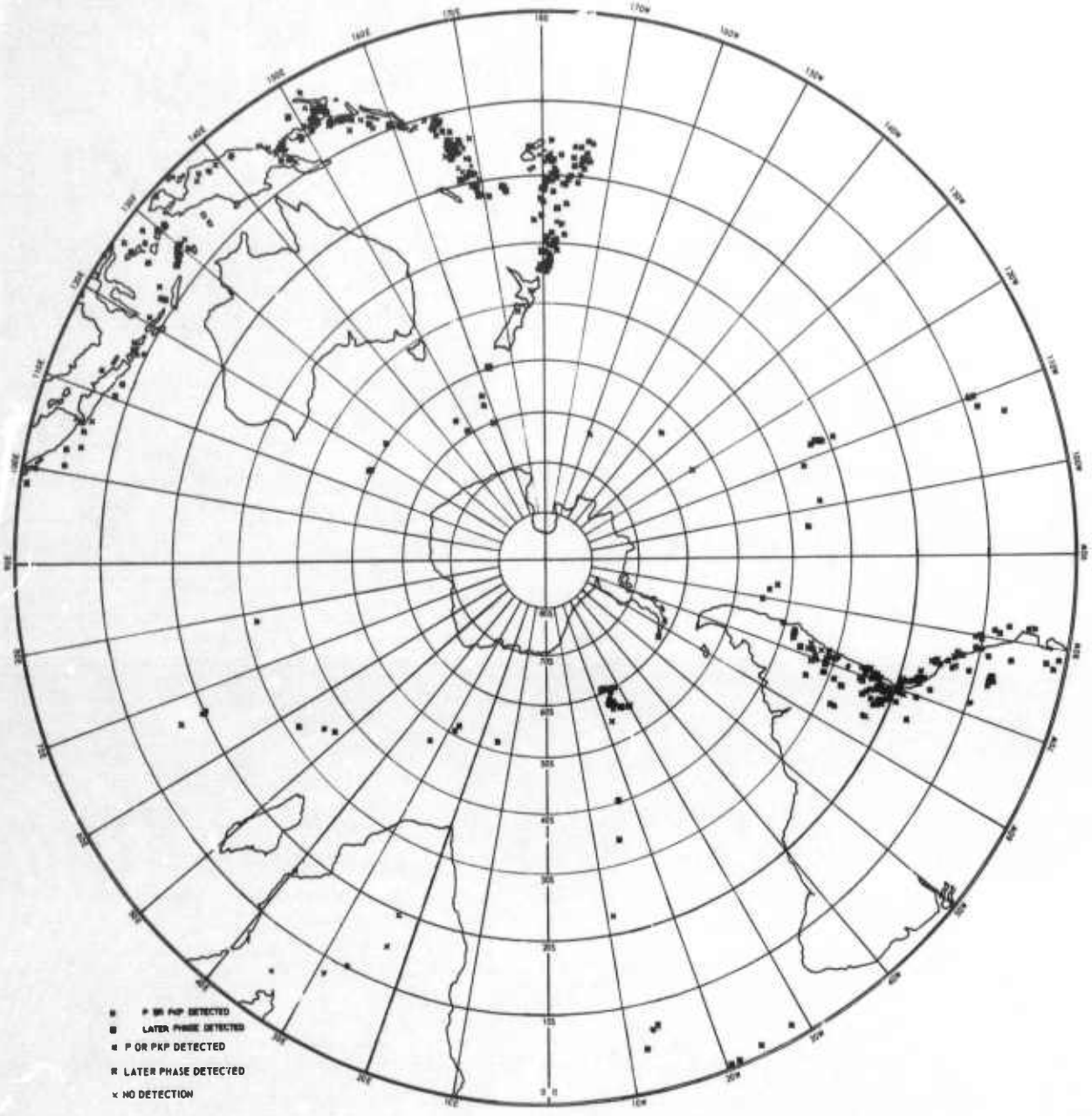

Figure 5. Distribution of Coast and Geodetic Survey located epicenters in the southern hemisphere for July, August, and September 1967

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6. MAINTAIN UBSO FACILITIES

Mr. William Jones, Kemper Insurance Company, was at UBSO to inspect the high-pressure systems. All high-pressure systems were found to be in order.

7. INSTRUMENT EVALUATION

7.1 TECHNICAL ASSISTANCE AND MONITORING OF SANDIA's UNMANNED SEISMOLOGICAL OBSERVATORY (USO)

Monitoring of the Sandia USO system was continued throughout the reporting period. On 6 December, the USO time code jumped to 1 January 1968. Sandia was notified of the change, but because of the scheduled deactivation of the system during the early part of 1968, Sandia does not plan to correct the time code output.

At the request of Sandia, UBSO personnel refilled the propane tank on 10 January 1968.

A letter report summarizing the usefulness of the USO was sent to the Project Officer on 7 November 1967. The main conclusions of the report were that the USO short-period vertical is comparable to an individual element of the shallow-buried array at UBSO, and that the USO long-period seismograph is not as satisfactory as the standard UBSO long-period seismograph.

7.2 EVALUATION OF VERTICAL ARRAY

The completion of the evaluation of the vertical array is pending the reinstallation of the array elements in the hole. Analysis of previously recorded data is complete.

8. ROUTINE NOISE MEASUREMENTS

Measurements of ambient noise in the 0.4- to 1.4-seconds period range are made daily at UBSO. Data are processed in Garland, and monthly cumulative probability curves of trace amplitude and ground displacement data are published. Noise data are reported from the SZ10, ΣSS, and ΣSSF seismograms. Noise curves for October, November, and December 1967 were sent to the Project Officer during this reporting period.

9. PROVIDE OBSERVATORY FACILITIES AND ASSISTANCE TO OTHER ORGANIZATIONS

9.1 DATA SENT TO THE UNIVERSITY OF UTAH

On 16 January, UBSO provided the University of Utah analysis data pertaining to several earthquakes occurring in the southwestern part of the state. The weekly summary of local and near regional events was furnished throughout the reporting period.

9.2 VISITORS

Geotech personnel from Garland were at UBSO throughout the reporting period for work on the triaxial system.

Dr. C. Barry Rayleigh and Mr. John H. Healy, C&GS, visited UBSO on 13 November 1967. Dr. Rayleigh was in the area to operate a portable seismograph system near the Rangely oil fields in conjunction with his studies of the possible generation of earthquakes by artifically increased fluid pressure.

10. REPORTS

a. Technical Report No. 67-73, Operation of the Uinta Basin Seismological Observatory, Quarterly Report No. 7, Project VT/6705, was mailed to the Project Officer on 11 December 1967.

b. Letter Report, Summary of the Unmanned Seismological Observatory at UBSO, was mailed to the Project Officer on 7 November 1967.

c. Letter Report, UBSO Long-Period Magnetic-Tape Seismograms, was mailed to the Project Officer on 15 December.

d. Approval was received for a technical report, Evaluation of Multiple Array Processors at the Uinta Basin Seismological Observatory. The report is being finalized and is scheduled for distribution in early February 1968.

APPENDIX to TECHNICAL REPORT NO. 68-13

STATEMENT OF WORK TO BE DONE

EXHIBIT "A"

STATEMENT OF WORK TO BE DONE

AFTAC Project Authorization No. VELA T/6705/S/ASD (32)

1. Tasks: 8 February 1966

a. Operation:

(1) Continue operation of the Uinta Basin Seismological Observatory (UBSO), normally recording data continuously.

(2) Evaluate the seismic data to determine optimum operational characteristics and make changes in the operating parameters as may be required to provide the most effective observatory possible. Addition and modification of instrumentation are within the scope of work. However, such instrument modifications and additions, data evaluation, and major parameter changes are subject to the prior approval of AFTAC.

(3) Conduct daily analysis of seismic data at the observatory and transmit daily seismic reports to the US Coast and Geodetic Survey, Wash DC 20230, using the established report format and detailed instructions.

(4) Record the results of daily analysis on magnetic tape in a format compatible with the automated bulletin program used by the Seismic Data Laboratory (SDL) in their preparation of the seismological bulletin of the VELA-UNIFORM seismological observatories. The format should be established by coordination with SDL through AFTAC. The schedule of routine shipments of these prepared magnetic tapes to SDL will be established by AFTAC.

(5) Establish quality control procedures and conduct quality control, as necessary, to assure the recording of high quality data on both magnetic tape and film. Past experience indicated that quality control review of one magnetic tape per magnetic tape recorder at the observatory each week is satisfactory unless quality control tolerances have been exceeded and the necessity of additional quality control arises. Quality control of magnetic tape should include, but need not necessarily be limited to, the following items:

(a) Completeness and accuracy of operation logs.

(b) Accuracy of observatory measurements of system noise and equivalent ground motion.

(c) Quality and completeness of voice comments.

(d) Examination of all calibrations to assure that clipping does not occur.

(e) Determination of relative phase shift on all array seismographs.

(f) Measurement of DC unbalance.

(g) Presence and accuracy of tape calibration and alignment.

(h) Check of uncompensated noise on each channel.

(i) Check of uncompensated signal-to-noise of channel 7.

(j) Check of general strength and quality of timing data derived from National Bureau of Standards Station WWV.

(k) Check of time pulse modulated 60 cps on channel 14 for adequate signal level and for presence of time pulses.

(l) Check of synchronization of digital time encoder with WWV.

(6) Provide observatory facilities, accompanying technical assistance by observatory personnel, and seismological data to requesting organizations and individuals after approval by AFTAC.

(7) Maintain, repair, protect, and preserve the facilities of the seismological observatory in good physical condition in accordance with sound industrial practice.

b. Instrument Evaluation: After approval by AFTAC, evaluate the performance characteristics of experimental or off-the-shelf equipment offering potential improvement in the performance of observatory seismograph systems. Operation and test of such instrumentation under field conditions should normally be preceded by laboratory test and evaluation.

c. Special Investigations: Conduct research investigations as approved or requested by AFTAC to obtain fundamental information which will lead to improvements in the detection capability of UBSO. These programs should take advantage of geological, meteorological, and seismological conditions at UBSO. The following special studies should be accomplished.

(1) Long term evaluation of the multiple array processor units.

(2) Installation and evaluation of a vertical array.

(3) Evaluation of the long-period vault.

(4) Provide technical assistance and monitor an unattended seismological observatory to be installed at UBSO in June 1967.

Research might pursue investigations in, but is not necessarily limited to, the following areas of interest: microseismic noise, signal characteristics, data presentation, detection threshold, and array design (surface and shallow borehole). Prior to commencing any research

investigation, AFTAC approval of the proposed investigation and of a comprehensive program outline of the intended research must be obtained.

2. Approval by AFTAC will normally be provided through the project officer.

3. Reports: Provide reports in accordance with the/requirements outlined in DD Form 1423 and attachment 1 thereto.

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13. ABSTRACT

This report describes the operation of the Uinta Basin Seismological Observatory (UBSO) from 1 November 1967 through 31 January 1968. Modifications and additions to the observatory instrumentation are described, and tests to improve the operations of the observatory are reported. Also discussed is the status of special investigations designed to evaluate and improve the detection capability of the observatory.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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